

## NOTES AND NEWS

*Lemanea* (RHODOPHYTA) IN MOUNTAIN STREAMS OF SOUTHERN CALIFORNIA.—This note calls attention to a population of *Lemanea* (Rhodophyta) in San Diego County and reviews the few other records, mostly very old, of this freshwater red alga in southern California.

In May 1978 clumps of stringy dark-colored plants were found on rocks in a stream flowing out of Japaca Springs on Cuyamaca Mountain (116°38'W, 32°58'N), between 1300–1500 m elevation. The coarse cylindrical strands, mostly about 5–10 cm, rarely up to 18 cm long, were tapered at both ends, unbranched and rough in surface texture. The collection was referred to *Lemanea*, subgenus *Paralemanea* (Silva, Taxon 8:60–64, 1959) in which axial filaments are surrounded by entwined longitudinal filaments, and spermatangia are in continuous bands encircling the thallus, dividing groups of carpospores. Smith (The Freshwater Algae of the United States, 1950) provides a general description of the morphology and development of *Lemanea* species. I know of only one published report mentioning the presence of *Lemanea* in California (Atkinson, Annals of Bot. 4:177–229, 1890; posthumous Notes, Bot. Gaz. 92:225–242, 1931).

The following *Lemanea* collections from southern California have been located (herbaria outside this State have not been surveyed):

San Bernardino County. Specimens collected by S. B. Parish, March to August, 1884–1897, from near Bloomington; some were distributed as part of the Phycotheca Boreali-Americana (UC, AHFH, RSA). Robert Thorne, at RSA, comments that the site described on the specimen label appears to be well away from both the San Gabriel and San Bernardino ranges.

Riverside County. Specimens collected by Parish, April 1896 (UC).

Kern County. Specimens collected by Van der Eike, November 1916, from Kern River, with Gardner accession number (UC).

San Diego County. Specimens collected by Parish, June 1897, from Doane Creek, Smith Mt. (UC); specimens collected by Fosberg, May 1929 from Palm Canyon, Borrego Valley (UC). The small herbarium of marine algae at Scripps Institution includes a single *Lemanea* sheet, collected by Marko Zalokar from “near campsite” Cuyamaca Mt. in June 1965.

Atkinson's study (Annals of Bot. 4:177–229, 1890) cites no specimens from southern California. The specimens from this region received between 1889 and his death in 1918 and discussed subsequently (Bot. Gaz. 92:225–242, 1931) were mostly deposited in the herbarium of Cornell University, although some of the Parish collections are now in California herbaria as noted above.

Attribution of the recently found Cuyamaca mountain plants to *L. annulata* is provisional. Atkinson, in 1890, referred specimens of '*L. catenata*' from Nevada in addition to all the then available specimens from northern California to *L. annulata*. In 1931, however, he recognized both species in the specimens collected by Parish in the southern localities mentioned above. C. M. Palmer, studying *Lemanea* at Butler University in Indianapolis in the early 1940s, annotated several of the older sheets presently in California herbaria. In some instances he confirmed Atkinson's earlier identifications, but in others the epithets *catenata* and *annulata* were reversed. The only specimen in the herbaria surveyed (other than Zalokar's) that definitely was not studied by Atkinson is the 1929 collection by Fosberg that Palmer determined as *L. catenata*. Type material for both species (Kützing, Phycologia germanica, 1845) from Europe must be studied with respect to California specimens before these can be attributed properly to one or both species. Clear distinctions between forms, varieties, or species apparently are lacking among other groups of taxa within the genus. Israelson (Symbolae Botanicae Upsalienses VI:1. A.–B. Lundequistska Bokhandeln, Uppsala, 1942) considered many described species in Europe to be variants of earlier-known species, with forms related to habitat or the season.

*Lemanea* thalli were again conspicuous in the same creek, but this time on rocks somewhat upstream from the site of the May collection, in July 1981. Water temperature (July) was 15°C and the pH was ~5. Vegetation along the edges of the flowing water included *Quercus agrifolia* Neé, *Rhus toxicodendron* L., *Rosa californica* Cham. & Schlecht., *Mimulus cardinalis* Dougl. ex Benth., *M. guttatus* Fisch. ex DC., *Urtica holosericea* Nutt., *Thalictrum* sp., *Aquilegia formosa* Fisch. in DC., and *Libocedrus decurrens* Torr., and *Apium graveolens* L. A bluegreen alga, *Nostoc* sp., grew in the creek, but not on the same rock with *Lemanea*.

This note establishes the recent presence of *Lemanea* in southern California and documents the scarcity of earlier collections. *Batrachospermum*, another freshwater red alga, according to holdings in the above-listed herbaria, grows in central and northern California but apparently has not been found in the southern counties. I was unable to find plants of either genus in numerous small lake-fed streams between 3300 and 4000 m in the southern Sierra Nevada in the summer of 1981. World wide, the Rhodophyta includes approximately 36 non-marine genera with 175 species (Dixon, Biology of the Rhodophyta, 1973). Smith (The Fresh-Water Algae of the United States, 1950) included about 32 species in 10 genera in the United States. This represents 5.2–5.7% of the known red algal taxa (Skuja, Bot. Rev. 4:665–676, 1938; Dixon, Biology of the Rhodophyta, 1973). Several of the freshwater taxa have rather restricted distributions geographically or by habitat but others are widely dispersed and have been intensively studied in Europe. Israelson (Symbolae Botanicae Upsalienses VI: 1. A.–B. Lundequistska Bokhandeln, Uppsala, 1942) writing about freshwater Swedish red algae, introduced a chapter on their ecology and distribution by stating that most “show a decided predilection for running water,” a comment perhaps quite applicable to *Lemanea*.

*Lemanea* is a panboreal genus, found between 10° and 70°N (Abyssinia to Arctic Scandinavia) with a center of distribution in North America, according to Skuja (Bot. Rev. 4:665–676, 1938). Smith (1950) lists “rapids, falls, mill dams, and the like” as typical habitats, following Atkinson who stressed the requirement for forceful currents. Israelson suggested that “within wide limits, the conditions of temperature seem not to be very important for the occurrence” of this genus. Atkinson similarly believed that cold water (but what did ‘cold’ mean to him?) may not be necessary.

*Lemanea* plants can be considered perennial because a filamentous prostrate stage persists throughout the year from which the clumps of erect macroscopic gametophytic thalli develop seasonally. Studies of populations in these dry, warm mountains of California should considerably amplify the understanding of the conditions that determine the distribution of this alga.

The macroscopic plant commonly observed is the monoecious haploid gametophyte. Magne (C.R. Acad. Sci. Paris, t. 265, p. 670–673, 1967) showed that meiosis occurs in the apical cells of very small *Lemanea* plants that grow from the diploid prostrate filamentous “Chantransia” stage.

Genera that reproduce in fresh water, as *Lemanea* does, are believed to have invaded these habitats from marine areas much earlier than other genera that propagate only vegetatively in fresh water. The more ancient freshwater species, including *Lemanea*, predictably may have evolved physiological, morphological, or life history characteristics that adapt them to non-marine conditions. In this respect, *Lemanea* already has proved useful for comparing photosynthesis in freshwater, marine, and terrestrial environments (Raven and Beardall, Br. Phyco. J. 16:165–175, 1981). Very recently, Pueschel and Cole (Am. J. Bot. 69:703–720, 1982) used ultrastructural data from plants of this genus in their suggested rearrangement of families into orders within Rhodophyta.

This genus has been overlooked for many years in southern California or else it has an extremely restricted distribution, either spatially or seasonally. Perhaps this note will challenge botanists in the field to seek additional contemporary localities where freshwater red algae grow and to deposit up-to-date records in herbaria where they can be used by other biologists.—JOAN G. STEWART, A-002, Scripps Institution of Oceanography, University of California, La Jolla 92093. (Received 25 Aug 1981; accepted 4 Nov 1982.)